ideational state, intensified, as it is, by the circumstances which surround it. So independent of volition is the influence of the ideational state in these cases, that it often operates in opposition to the dictates of the Will, and the writer has himself seen, more than once, answers extorted, as it were, from a member of a *séance*, unwillingly on his part, simply in consequence of his own highly-strained ideational condition conveying a knowledge through his muscles to those who sat with him at the innocent and obedient piece of furniture. Dr. Carpenter also shows that under this head of Ideo-motor action may be ranged "all those actions performed by us in our ordinary course of life," such as the use of language to express our thoughts, which requires no separate volitional effort, at all events when once we have entered on a train of speech.

But though giving up so large a field of human life to the non-volitional activity, Dr. Carpenter still keeps the Will in view, as a sort of abstract entity, as a "suppositius," or reserve champion sitting in wait, ready to step in if occasion should call. "The dominant Idea *determines* these movements, the Will simply *permitting* them."

We can give in a few words a summary of Dr. Carpenter's theory of the relation of the Emotions to the Will. He begins by saying that "the Will has no *direct* power over the emotional sensibility," it can only operate to withdraw the attention from the emotional state and fix it determinately upon some other object. Again, the Will "can exert itself in preventing the *expression* of the exerted feelings in action" by suppressing the muscular exhibition of our emotional states; and again, "where the Emotion is not a mere *passion*, but is a state of *feeling* connected with some definite *idea*, the power of the Will is most effectually exerted in withdrawing the mind from the influence of that idea, by *fixing the attention upon some other*"—the power of self-control extends itself from our *impulses* to the habitual *succession of the thoughts*.

We had already learnt our author's views on the relation of the Will to mental and bodily action, but in the middle of his treatise we come upon a full and careful amplification of his opinions on this head, developing his theory of the influence of the Will on the formation of beliefs and on the conduct. We cannot do better than give in his own words Dr. Carpenter's doctrine on the latter head:—

> "To carry into *action* the volitional determination, to give to the 'I will' its practical effect, something more is usually needed than the mere preponderance of motives. The idea of *the thing to be done* (which we have seen to be the necessary antecedent of all volitional action) may indeed be so decided and forcible, when once fully adopted, as of itself to produce a degree of nervous tension that serves to call forth respondent muscular movements, as in the purely ideo-motor form of action. But in general a distinct exertion of the Will is needed to give to the ideational state the energy requisite to call forth the action that expresses it, and this is especially the case where either some powerfully opposing motive diminishes the force of the preponderance, or a state of fatigue causes the bodily mechanism to be less easily called into action."

Hitherto we have been dealing with what the author calls "General Physiology;" we come now to the other division of the work, on "Special Physiology," and the transition is marked by a change of matter and style. We feel that, in reading this latter portion of the book we are being rewarded for the care which is necessary to the mastery of the deeper and more valuable philosophy of the earlier chapters. We have got—we do not speak disrespectfully—out of school into the playground, and we revel in the contemplation of the "morbid conditions" of the mind, illustrated as they are by numerous relevant anecdotes. Mesmerism, somnambulism, and dreaming are all subjects which attract and entertain, especially when treated of by a scientific pen. But we feel that this portion of the work does not call for special criticism so much as what we have already gone through. "Morbid conditions" are very valuable as throwing light on the operation of normal and healthy conditions, but happily the epithet "morbid" is interchangeable with the epithet "exceptional," and therefore we think that the morbid does not require such close treatment as the normal.

Dr. Carpenter winds up his work with a chapter on Mind and Will in Nature, and in it brings to a poetical conclusion what he has so carefully and exhaustively unravelled in the preceding pages.

## *ANDRÉ AND RAYET'S "PRACTICAL ASTRONOMY"*

*L'Astronomie pratique et les Observatoires en Europe et en Amerique.* Par C. André et G. Rayet. Ie partie, Angleterre. (Paris: Gauthier-Villars. 1874.)

THIS little unpretending volume is of considerable importance. Not only is it the commencement of a series which is intended to include the history of practical astronomy throughout the civilised world, but independently of this, it has claims to notice which are not to be measured by its limited dimensions.

The wide outspreading in the present day of a taste for astronomical observation would lead us to regard with favour anything tending to increase our knowledge of what has been and is being done, especially when it is set before us in so pleasing a form; and we cannot but admit that our neighbours have in this respect got the start of us. Notwithstanding all our efforts to render Science generally intelligible and acceptable, we have not yet succeeded in bringing out such attractive little manuals as proceed from the presses of MM. Gauthier-Villars and Hachette. Our larger and more elaborate treatises may well bear a comparison with anything of a similar calibre produced elsewhere; but in familiar, inexpensive, tasteful manuals, the light artillery, so to speak, of the scientific campaign, we must own ourselves fairly beaten by our nearest neighbours, who have set us a worthy example. We cannot, happily, and if we could we would not, say in this instance, *fas est et ab hoste doceri*. There was a time when such a remark would have been thought appropriate, but "nous avons changé tout celà;" and if such a thoroughly ill-natured and reprehensible observation were to be attempted now, it would meet its ample refutation in this work, which adds to its other merits the charm of courteous and kindly feeling. Next to the cordial abandonment of individual hostility, or the loving, tender reconciliation of alienated friendship, what can be more pleasing than the abatement of national antipathies and the softening down of those asperities which have but too deeply marked the

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intercourse of different branches of the human race? That nations should think or feel exactly in unison is no more to be expected than that individuals of the same family should possess identical tastes and habits; but as in the smaller, so in the larger groups, these distinctive characters may and ought to exist apart from every unkind jealousy or envious bitterness. There had been far too much of this in past days, and we hail with pleasure the appearance of this friendly book, which has evidently been drawn up in a truly kind and genial spirit.

If it puts us somewhat to shame, that the Assistant-Astronomers of the Paris Observatory should be telling us what goes on at our own doors, we have only ourselves to thank for the omission, and them for the way in which they have supplied it. The plan they have adopted is an excellent one; and as to its execution there is very much to praise. A history of English observatories and their work could not be otherwise than somewhat unequal in its execution; it would probably be so to some extent even in native hands; to a foreigner, who must, generally speaking, depend upon communicated information, the difficulty would be insuperable; and to this cause we may evidently refer the omission of some finely appointed private observatories, such as those of the Rev. H. C. Key, with its 18-inch silvered speculum, of Mr. Bird, the Rev. E. L. Berthon, Capt. Noble, Mr. Neison, Mr. Barnes, and many others. It is, in fact, in these private "telescope-houses" that England is so rich, as was formerly remarked in substance to the present writer by M. Léon Foucault, and it is through their work that much of the physical astronomy of the day has been advanced to its present position. But this is exactly what would escape the notice of any but ourselves, and even the generality of ourselves; and in this respect there is, of course, a good deal of deficiency in the work which cannot well be blamed. But great pains have evidently been taken to insure correctness, and to impart knowledge which to many among ourselves will have all the interest of novelty; and this has been done, for the most part, as far as we can judge, in a very satisfactory way.

The French language is now so generally understood among us that a translation is perhaps not required; but should it be undertaken, or should the authors, as we hope, be encouraged to send forth another impression, we would request permission to offer a few suggestions. The Bedford Catalogue, which has had so marked an influence on English astronomy, would well come in for a share of notice: the names of the opticians, whose work is described—which are seldom given, and perhaps not always correctly—might be supplied with advantage; several orthographical slips, and one considerable error in the little map, might be rectified. With these improvements, and some difference in the arrangement and appropriation of the very pretty illustrations, this charming little volume, even now greatly to be commended, would meet our expectations in every way. T. W. W.

## *LETTERS TO THE EDITOR*

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

### Quantitative Relations of Cause and Effect

AFTER Mr. Spencer has implied that he will not himself continue the controversy further, Mr. Hayward, in his last letter, has confused the issues by misstating Mr. Spencer's position. In the circumstances, perhaps, it will not be improper for me, as one familiar with Mr. Spencer's psychological doctrines, to rectify Mr. Hayward's error and explain that which he misapprehends.

The cue may be taken from an experience described in Mr. Spencer's "Principles of Psychology" (§ 468, note), where it is shown that when with one hand we pull the other, we have in the feeling of tension produced in the limb pulled a measure of the reaction that is equivalent to the action of the other limb. Both terms of the relation of cause and effect are in this case present to consciousness as muscular tensions, which are our symbols of forces in general. While no motion is produced they are felt to be equal, so far as the sensations can serve to measure equality; and when excess of tension is felt in the one arm, motion is experienced in the other. Here, as in the examples about to be given, the relation between cause and effect, though numerically indefinite, is definite in the respect that every additional increment of cause produces an additional increment of effect; and it is out of this and similar experiences that the idea of the relation of proportionality grows and becomes organic

A child, when biting its food, discovers that the harder he bites the deeper is the indentation; in other words, that the more force applied, the greater the effect. If he tears an object with his teeth, he finds that the more he pulls the more the thing yields. Let him press against something soft, as his own person, or his clothes, or a lump of clay, and he sees that the part or object pressed yields little or much, according to the amount of the muscular strain. He can bend a stick, the more completely the more force he applies. Any elastic object, as a piece of india-rubber, or a catapult, can be stretched the farther the harder he pulls. If he tries to push a small body, there is little resistance and it is easy to move; but he finds that a big body presents greater resistance and is harder to move. The experience is precisely similar if he attempts to lift a big body and a little one; or if he raises a limb, with or without any object attached to it. He throws a stone: if it is light, little exertion propels it a considerable distance; if very heavy, great exertion only a short distance. So, also, if he jumps, a slight effort raises him to a short height, a greater effort to a greater height. By blowing with his mouth he sees that he can move small objects, or the surface of his morning's milk, gently or violently according as the blast is weak or strong. And it is the same with sounds: with a slight strain on the vocal organs he produces a murmur; with great strain he can raise a shout.

The experiences these propositions record all implicate the same consciousness—the notion of proportionality between force applied and result produced; and it is out of this latent consciousness that the axiom of the perfect quantitative equivalence of the relations between cause and effect is evolved. To shew how rigorous, how irreversible, this consciousness becomes, take a boy and suggest to him the following statements:—Can he not break a string he has, by pulling? tell him to double it, and then he will break it. He cannot bend or break a particular stick: let him make less effort and he will succeed. He is unable to raise a heavy weight: tell him he errs by using too much force. He can't push over a small chest: he will find it easier to upset a larger one. By blowing hard he cannot move a given object: if he blows lightly he will move it. By great exertion he cannot make himself audible at a distance: but he will make himself heard with less exertion at a greater distance. Tell him to do all or any of these, and of course he fails. The propositions are unthinkable, and their unthinkableness shows that the consciousness which yields them is irreversible. These, then, are preconceptions, properly so called, which have grown unconsciously out of the earliest experiences, beginning with those of the sucking infant, are perpetually confirmed by fresh experiences, and have at last become organised in the mental structure.

It is not, however, any such experiences which Mr. Hayward adduces to exemplify organic preconceptions. He asserts that his "principal 'exemplification of unconsciously-formed preconceptions' was of Mr. Spencer's own choosing, namely, Newton's 'Second Law of Motion.'" This is an error: Mr. Spencer gave *no* examples of unconsciously-formed preconceptions. If Mr. Hayward will refer to Mr. Spencer's letter in NATURE, vol. ix. p. 462, he will find that Mr. Spencer has described the unconsciously-formed notion of the relation between cause and effect in general terms, and without example or illustration. In his last letter he simply named the relation between muscular tensions and their effects. Probably he expected Mr. Hayward to seize his meaning without any specific example.

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